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Abyssal Hill Roughness Impact on Internal Tide Generation: Linear Theory

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Internal tide driven mixing plays a key role in sustaining the deep ocean stratification and meridional overturning circulation. Internal tides can be generated by topographic horizontal scales ranging from hundreds of meters to tens of kilometers. State of the art topographic products hardly resolve scales smaller than ~10 km in the deep ocean, over which abyssal hills are the dominant ocean floor roughness fabric. An evaluation of the impact of abyssal hill roughness on internal-tide generation is presented in this study. The conversion of the M2 barotropic to baroclinic tidal energy is calculated based on the linear wave theory using the Shuttle Radar Topography Mission SRTM30_PLUS bathymetric product at 1/120 degree resolution with and without the addition of synthetic abyssal hill roughness. Internal tide generation by abyssal hills integrates to 0.1 TW globally (i.e. ~10% of the energy flux due to larger topographic scales resolved in standard products) and is dominated by mid-ocean ridges, where abyssal hills roughness is large. Focusing on two regions located over the Mid-Atlantic Ridge and the East Pacific Rise, it is shown that regionally the increase of the energy flux due to abyssal hills can reach up to 100%, or 50% when a crude correction for supercritical slopes contribution is attempted, and that small scales of the bathymetry strongly contribute to the energy conversion. Therefore, abyssal hills, unresolved in state of the art topographic products, can have a strong impact on internal tides generation, especially over mid-ocean ridges.

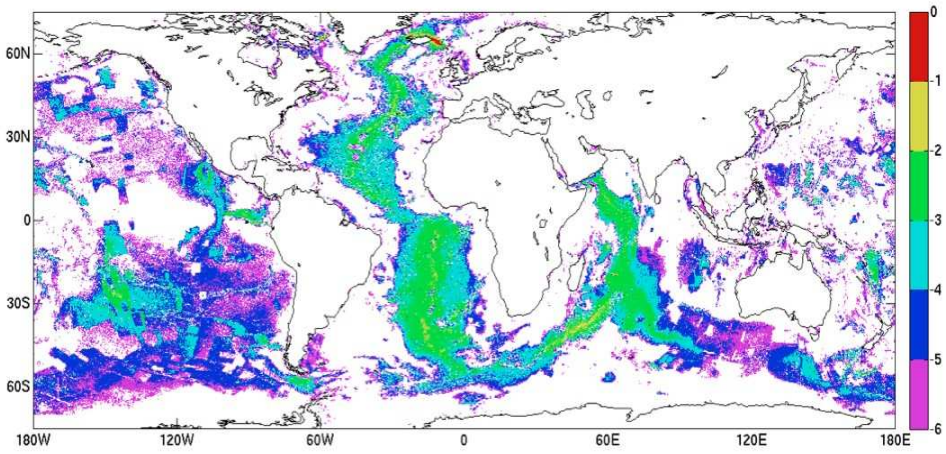

Figure 1: Abyssal Hills contribution to the enrgy flux from the M2 tide into internal tides (in log10, W/m2)

1. A. Melet, M. Nikurashin, C.J. Muller, S. Falahat, J. Nycander, P. Timko, B. Arbic, J. Goff (2013) "Abyssal Hill Roughness Impact on Internal Tide Generation: Linear Theory", Journal of Geophysical Research - Oceans, Submitted